R95-9

Computer-Based Optimization Of Concepts For Military Ration Packaging

Howard R. Moskowitz
Greg Graves
Moskowitz Jacobs Inc.
White Plains, New York

Armand Cardello
Larry Lesher
U.S. Natick R&D Center
Natick, Mass.

Presented At The 1994 R&D Associates Meeting
Boston, Mass.

TITLE: Computer-based optimization of concepts for military ration packaging.

AUTHORS: Howard R. Moskowitz, Greg Graves (Moskowitz Jacobs Inc.)
Armand Cardello, Larry Lesher (U.S. Natick R&D Center)

ABSTRACT: Packaging is a critical factor impacting the behavioral response to foods. Food packaging must be informative, visually appealing, and functional. Traditional approaches to package design rely on experts to create concepts and executions that are subsequently assessed by users. There are two distinct patterns to the assessment: aesthetic and functional. In the case of consumer packages, concepts are designed to promote purchase. In the case of the military rations, concepts focus on the functionality of the package. Whether we deal with consumer or military packages it is difficult to identify those features which drive acceptance. A research procedure which identifies the key elements promoting acceptance (vs rejection) would have great promise for making package design more effective.

The present study was conducted as part of a Cooperative Research & Development Agreement (CRDA), with five goals: 1) identify the key package factors or drivers of soldier acceptance for rations 2) segment soldiers on the basis of preference patterns, 3) optimize ration package concepts, and 4) demonstrate the utility of a computer based system for stimulus presentation, data acquisition, and package design optimization.

The empirical data was obtained from 109 soldiers, stationed at Ft. Lewis, WA. Each soldier evaluated a totally unique set of 100 different combinations of package features, presented on a computer screen. [Presentation combined visuals and text description]. The results yielded models showing the contribution of every element to soldier acceptance of ration packages. The data also was used to identify 2 distinct preference segments -- Segment 1 interested strictly in functionality (ease of use, lots of food), and Segment 2 interested in self-heating features and warm meals.

The results of the study allow the researcher to identify the key drivers, and then to optimize the package design for either the total panel, or for each soldier segment, respectively.

Introduction

Packaging plays a critical role in products, for without packaging product quality would be significantly impaired. It is fair to say that without proper packaging many of the products that we consume today simply would not be chosen, and thus not eaten. This paper presents a newly developing technology in consumer research which allows the consumer to select the characteristics of a package and thus actively participate in the design process. The technology presented here provides the package developer with a new capability to incorporate consumer feedback in an inexpensive, pro-active fashion, while there are still many options available for the package. The technology is developing, and thus is still "in progress".

The ever increasing sophistication and power of computers enables product and package developers to insert the consumer earlier and more usefully into the design process. Each year brings new graphics technology and more efficient ways to obtain consumer data. Thus the results obtained here on military rations represents the "state of the art" as it was in 1993, when the project was conceived. After the results section we show how the current approach can produce even more usable results, by incorporating video and graphical "transparencies" into the design process.

Conjoint Measurement - The Underlying Research Framework

Packages comprise mixtures of features including actual design of the physical container as well as its graphics. The consumer responds to these characteristics in combination, rather than singly (Green & Srinivasan, 1990). It is not optimally effective to probe consumer responses to each component presented alone, when in actual use the combination of characteristics will be the driving force for the consumer's response. Researchers in psychology recognized this more than

30 years ago. In the normal environment most stimuli are complex mixtures. Yet, it is the nature of scientists and engineers to reduce the response to a mixture down to the responses of the components. Package designers are no different.

Over the past 25 years researchers in marketing have studied responses to complex mixtures in order to discover what features of the mixture drive consumer response. The method is known as conjoint analysis (Moskowitz, 1994). Typically used to assess reactions to concepts which comprise various benefits, conjoint analysis is equally suited to the analysis of products or packages whose features have been systematically varied (Green & Srinivasan, 1990). Conjoint analysis decomposes the response to the package, and identifies which particular features drive acceptance or other consumer reactions. Conjoint analysis estimates numerical utilities, or actual part-worth contributions of components to the "whole". Armed with these utilities the developer or marketer can then re-combine the elements of a package, product or concept into a new stimulus, comprising the best performing elements). The newly optimized combination may not have been directly tested, but would have the potential to be a substantially better performer if tested with the same or a matched set of consumers (see Moskowitz, 1981).

Method & Results - Current Study

This study will deal with package design using IdeaMap (Moskowitz, 1994). Applied conjoint analysis using IdeaMap in its most basic form requires that the developer or researcher follow these 8 steps. The steps are appropriate whether the stimuli be packages, products, or concepts/communications. The steps are listed below, along with examples from the current package study.

<u>Step 1 - Resource Development</u> - Identify the features which vary. For packages, these comprise statements (verbal material) and visuals (graphics material), all appropriate to the MRE (meal, ready to eat). These elements are the resources or

building blocks of the package. Table 1 shows ten elements from the full set. The actual study comprised 300 different elements. The elements were obtained from soldiers during focus group interviews at various military posts around the U.S.

Table 1
Ten Representative Elements Included In The Package Design Study

- Hot meals
- Performance Pack
- A package that's easy to use, to carry, and to unpack
- Larger portions to satisfy your hunger
- Self-heating tray inside a box
- Self-heating tray inside a heat-sealed plastic bag
- The package has larger portions and more spices
- Wholesome food with lots of variety!
- Meal (VISUAL)
- Map of U.S. with silhouette of soldier (VISUAL)

Step 2 - Bookkeeping. Bookkeeping is divided into 3 parts:

a) Categorize - Classify these variables into categories. The categories can be names, benefits, visuals (static, moving). For this project on packages there were 4 verbal categories (statements about functionality, catch phrases, names, package structures), and 1 category showing the visual aspects of the package. The categorization is a subjective task, and is usually done by a small number of people through discussion.

b) Dimensionalize - locate all of the elements on a set of non-evaluative semantic scales. Dimensionalization is also a subjective task, but quantitative, rather than qualitative. Dimensionalization is done by 5-25 people through a questionnaire. A small group of panelists (matched to the ultimate target group) locate these elements, using anchored 9 point scales. Table 2 shows the averages from a set of 15 soldiers (stationed at Ft. Devens), who dimensionalized the elements.

Table 2 Locations Of 11 Elements On 6 Semantic Scale Dimensions						
Element	A	B	C	D	E	F
Field Break (name)	5	8	4	3	5	7
Ziploc plastic bag with a tear strip across top	5	6	6	5	7	6
Resealable aluminum tray with pull and a plastic lid	6	5	5	6	6	4
Plastic covered container (like lunch bucket)	5	4	4	6	5	3
The package has larger portions and more spices	7	7	6	7	7	4
Food that is appetizing, and convenient!	6	8	7	5	7	6
Great taste and with an extra boost of energy	6	8	7	5	6	6
Reduced fat and salt	6	6	6	6	6	5
Made by America's best!	6	6	7	6	6	6
From Uncle Sam's kitchen!	5	6	6	6	6	5
Flag and stars (visual)	5	6	6	5	5	4
Key:						
Dim A: 1=ordinary, 9=unique						
Dim B: 1=not for field, 9=for field						
Dim C: 1=artificial, 9=natural						
Dim D: 1=a snack, 9=a full meal						
Dim E: 1=hard to use, 9=-easy to use						
Dim F: 1=bulky, 9=compact						

c) Restrict - identify pairs of elements that cannot logically go to together" in the same concept, even though each element can logically appear with many other elements. Table 3 shows two pair-wise restrictions. When creating concepts the restrictions are used to insure that no incompatible elements ever appear together.

1

Table 3 Restrictions Of Two Pairs Of Incompatible Elements	
If:	**Then Not:**
The Package is biodegradable and produces minimal trash	In a new package that's durable, light-weight, and biodegradable!
A good portion size that is easy to eat	Larger portions to satisfy your hunger

<u>Step 3 - Create Concepts According To An Experimental Design.</u> The objective of the research is to identify which specific elements drive consumer ratings. To do so requires that the elements appear in concepts in a way which makes these elements "statistically independent of each other", so that their individual contributions may be estimated. The experimental design lays out specific combinations with the property that the elements are statistically independent. The experimental design is only a schematic, however, and lacks substantive content. The experimental design simply prescribes the formal structure of the concept. It is left to the researcher to decide what elements will appear in each category.

In this study each soldier panelist rated package concepts developed from 4 different experimental designs. Each experimental design comprised 4 elements chosen from the 5 categories, and arrayed into 25 combinations. Table 4A shows the schematic of the design (Plackett Burman screening design; Plackett & Burman, 1946). Table 4A shows 5 of the 25 combinations. Every design comprises 5 categories, denoted as Categories A - E. Each category comprises 4 elements (1-4), and a "null condition" (0). Consider the schematic concepts shown in Table 4A. The first concept requires that no element from Category A appear, that element #3 from Category B appear, that element #1 from Category C appear, etc. Although the schematic is the same from design to design (viz., each set of 25 concepts), the which specific categories correspond to categories A-E, and which specific elements corresponds to elements 1-4 will vary person by person.

Table 4A
5 Variable Plackett Burman Design
First 5 Combinations

A	B	C	D	E
0	3	1	3	3
4	0	3	1	3
1	4	0	3	1
1	1	4	0	3
2	1	1	4	0

Across all 109 soldier panelists there were a total of 436 different experimental designs. Each soldier rated 100 concepts (4 designs of 25 concepts each), with the 100 concepts from the 4 different designs appearing in totally randomized order to prevent boredom. The designs were set up to ensure that each element in the study appeared approximately equally often. There were no repeat concepts among the 10,900 combinations tested by the 109 soldiers.

Table 4B shows 2 example of concepts. These concepts appeared on a color computer screen, with the actual visuals shown in the concept, rather than described as they are in Table 4B.

Table 4B Two Examples of Concept Combinations
<u>Panelist 101</u> ■ Power pack ■ Self-heating tray inside box ■ The ration is lightweight and compact ■ Food that is appetizing, and convenient! ■ Meal (visual)
<u>Panelist 102</u> ■ Uncle Sam (visual) ■ Made by America's best! ■ The ration is easy to prepare ■ Plastic covered container (like lunch bucket) ■ Hearty Helpings

<u>Step 4 - Collect The Data From Consumers (Soldiers).</u> Respondents were 109 soldiers of the 593D Corp support Group, located at Ft. Lewis, Washington. Each soldier panelist rated 100 combinations during a computer-based interview lasting approximately 25 minutes. At the start of the interview the soldier was oriented to the use of the computer, and to the study scale. The soldier then read a positioning statement, designed to focus the soldier on an individual ration concept:

"All of the concepts you are about to see refer to MRE's (meal, ready to eat)"

Then, the computer presented the panelist with the package concepts, one at a time. Each panelist rated every one of the 100 test concepts on a 9 point scale for "interest". A rating of 1 denoted absolutely no interest. A rating of 9 denoted an extreme amount of interest. The entire study was done on Intel based computers, equipped with color monitors.

Although the data were collected from soldiers stationed at Ft. Lewis, the technology is sufficiently portable to make it useful as a data collection procedure in almost any location. The computer does all of the work in combining the different elements to create test concepts. The computer resources are minimal for the interview - merely a schematic design, hard-disk storage for the different pictures and phrases, and the program for the computer to combine pictures and words 'on the fly' according to the schematic experimental design.

Step 5 - Estimate The Contribution Of Each Individual Element To Soldier Interest By Dummy Variable Regression Analysis. What is of interest in this study is the utility or attractiveness of each package element. Although the package elements were presented in combination, the experimental design shown in Table 4A ensures that every element appears independently of every other element. The data allow the researcher to create a model relating the presence / absence of every package element to the soldier's rating. Since every soldier rated 100 combinations, comprising a total of 80 elements, the regression equation for each panelist comprised 80 independent variables (one for each element). There were thus 80 predictors and 100 observations (one for each of the 100 concepts). The elements (independent variables) are statistically independent of each other, and are thus appropriate predictors in regression model.

The, rating for each package concept were re-coded to a binary scale. Ratings of 1-6 were re-coded as 0, ratings of 7-9 were re-coded as 100. Thus both the independent variables (package elements) and the dependent variable (interest) were binary, taking on one of two values only. The coefficient for an element in the resulting regression equation represent the additive condition probability of a soldier saying that he would be interested in the package, given the presence of the element in the package concept.

Step 6 - Estimate The Utility Of Non-Tested Package Elements. Although each soldier evaluated 100 concepts comprising a total of 80 elements, no soldier evaluated all elements in the study. For subsequent analyses, such as concept response segmentation, it is important to estimate the utilities of non tested elements for each soldier. Estimating missing data is straightforward when the independent variables are continuous. There are many interpolation procedures available through the techniques of numerical analysis. For 300 discrete elements, however, coming from different categories (packages, names, etc.) there is no standard interpolation procedure. There is a method, however, to interpolate. The method involves the use of "computational grids" (Szabo & Babuska, 1991). Appendix I presents the method.

<u>Step 7 - Segment The Consumers On The Basis Of The Patterns Of Their Utilities.</u> Marketers know that consumers differ in what they like or dislike, and that almost always these individual differences cannot easily be traced to demographic patterns. It may well be that there are segments among soldiers in the package features that drive their interest. The segmentation method has been already described in detail (see Moskowitz, 1994; Moskowitz, Jacobs & Lazar, 1985). Appendix II presents the segmentation procedure.

The results suggest two clearly distinct segments. Segment 1 (51% of the population) consists of soldiers who are primarily interested in the performance of the package. They want a usable package, durable, lightweight, biodegradable, and in general a package that is rugged, robust, and usable. Segment 2 (49% of the population) are more interested in "creature" comforts (e.g., self heating, warm meals emerging from the packaging). These segments are not totally opposite in their wishes. Rather, these segments represent two parts of a continuum, with each segment emphasizing different benefits.

We can see the differences between these two segments in Table 5. Table 5 shows the winning and losing elements for 5 key subgroups of soldiers: total panel, segments 1 vs 2, and two other subgroups, those soldiers who had spent up to 10 days in the field vs those soldiers who had spent 11+ days in the field. The winning concept elements for two concept-response segments dramatically differ from each other, whereas the winning concept elements based upon time spent in field are far more similar.

Table 5A
High and Low Performers Across Total Sample

	Total Sample	Seg. 1 Function.	Seg 2 Self-heating	<=10 days in field	> 10 days in field
The package has larger portions and more spices	14	12	15	14	12
Wholesome food with lots of variety!	13	16	10	14	12
Larger portions to satisfy your hunger!	13	13	12	11	15
In a new package that's durable, lightweight, and biodegradable!	12	19	4	13	10
From Uncle Sam's kitchen!	-3	-4	-1	-4	-1
Large cornucopia	-3	-1	-5	-2	-4
Resealable aluminum tray with pull and a plastic lid	-4	-5	-4	-3	-7
TV-dinner tray + foiler cover	-6	-7	-4	-4	-9
Small can with pull-tab	-13	-15	-11	-13	-13
Cardboard box with glued- ends	-22	-19	-25	-20	-26

Table 5B
High and Low Performers For Segment 1 (Functionality-Oriented)

	Total Sample	Seg. 1 Function.	Seg 2 Self-heating	<=10 days in field	> 10 days in field
In a new package that's durable, lightweight, and biodegradable!	12	19	4	13	10
The package is biodegradable and produces minimal trash	11	16	5	6	19
Wholesome food with lots of variety!	13	16	10	14	12
A package is water and insect proof	9	14	5	9	10
Larger portions to satisfy your hunger!	13	13	12	11	15
The package has larger portions and more spices	14	12	15	14	12
High protein and more fiber!	8	12	3	9	6
A good portion size that is easy to eat	7	12	3	9	4
From Uncle Sam's kitchen!	-3	-4	-1	-4	-1
Resealable aluminum tray with pull and a plastic lid	-4	-5	-4	-3	-7
TV-dinner tray + foil cover	-6	-7	-4	-4	-9
Small can with pull-tab	-13	-15	-11	-13	-13
Cardboard box with glued- ends	-22	-19	-25	-20	-26

Table 5C
High and Low Performers For Segment 2 (Comfort, Heating)

	Total Sample	Seg. 1 Function.	Seg 2 Self-heating	<=10 days in field	> 10 days in field
Self-heating tray inside a heat-sealed bag plastic	11	6	17	11	12
Hot Meals	10	6	15	11	10
The package has larger portions and more spices	14	12	15	14	12
The package contains popular foods and a self-heater	11	9	13	9	14
Large cornucopia	-3	-1	-5	-2	-4
Small can with pull-tab	-13	-15	-11	-13	-13
Cardboard box with glued- ends	-22	-19	-25	-20	-26

Table 5D
High and Low Performers Across Soldiers Who Spent 10 Days or Less in Field

	Total Sample	Seg. 1 Function.	Seg 2 Self-heating	<=10 days in field	> 10 days in field
The package has larger portions and more spices	14	12	15	14	12
Wholesome food with lots of variety!	13	16	10	14	12
In a new package that's durable, lightweight,& biodegradable!	12	19	4	13	10
A durable package that is tamper proof	7	8	5	11	-1
Larger portions to satisfy your hunger!	13	13	12	11	15
Hot Meals	10	6	15	11	10
Self-heating tray inside a box	7	3	11	11	1
Self-heating tray inside a heat-sealed plastic bag	11	6	17	11	12
Small can with pull-tab	-13	-15	-11	-13	-13
Cardboard box with glued- ends	-22	-19	-25	-20	-26

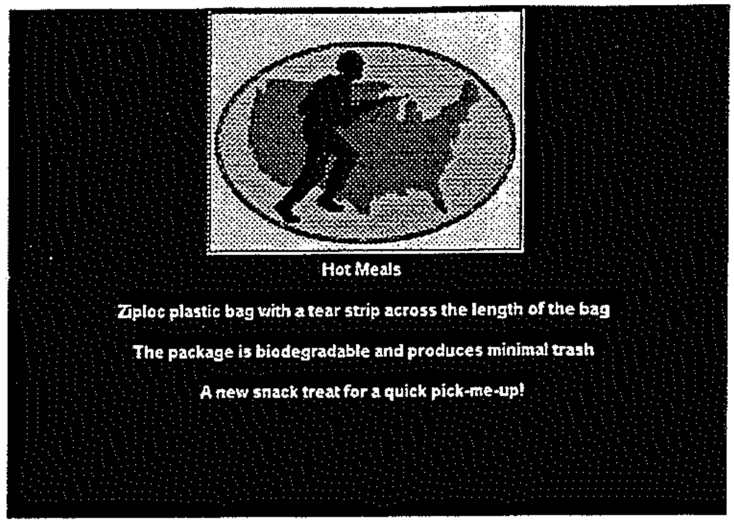
Table 5E
High and Low Performers Across Respondents Who Spend 11 or More Days in Field

	Total Sample	Seg. 1 Function.	Seg 2 Self-heating	<=10 days in field	> 10 days in field
The package is biodegradable and produces minimal trash	11	16	5	6	19
Larger portions to satisfy your hunger!	13	13	12	11	15
The package contains popular foods and a self-heater	11	9	13	9	14
The package has larger portions and more spices	14	12	15	14	12
Wholesome food with lots of variety!	13	16	10	14	12
Self-heating tray inside a heat-sealed bag plastic	11	6	17	11	12
Resealable aluminum tray with pull and a plastic lid	-4	-5	-4	-3	-7
TV-dinner tray with foil cover	-6	-7	-4	-4	-9
Small can with pull-tab	-13	-15	-11	-13	-13
Cardboard box with glued- ends	-22	-19	-25	-20	-26

Step 8 - Optimize Package Concepts By Combining Winning Elements. The final research step occurs after the study is completed. The elements, the dimensions, and the restrictions comprise half the database. The other half of the database comprises the part-worth contributions or utilities of the individual elements, either from the total panel or from the key subgroups. Given this information it becomes possible to recombine the elements into new combinations (viz., new package concepts) which look like they have more promise. The method for combining the concepts is known as integer optimization. Integer optimization is appropriate because the variable under the developers control (viz., the elements) can take on only one of two values - absent (coded as 0) or present (coded as 1).

Figure 1 shows a highly acceptable package concept for the total panel. Figure 2 shows a package concept which is acceptable and relatively unique from the soldier's point of view.. Figure 3 shows a relatively unique package concept, but one designed without necessarily considering soldier acceptance.

Figure 1 - Highly Acceptable Package



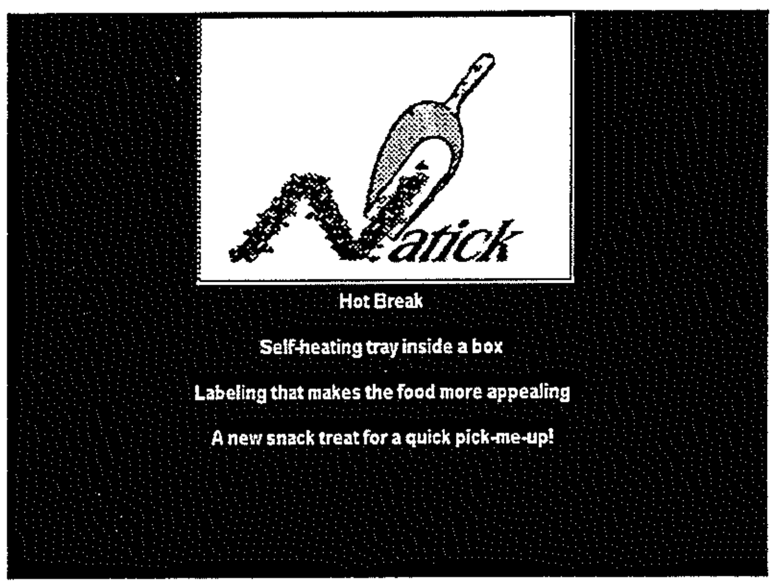
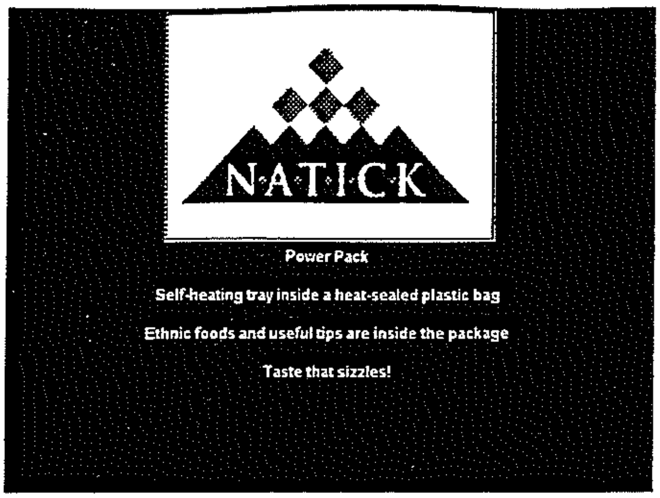


Figure 2 - Acceptable & Unique Package

Figure 3 - Unique package concept



Utility Of The Approach For Package Designs

Up to now most researchers have been forced to narrow the scope of their package research. Research has been passive - with panelists ratings rating the acceptance of a limited number of designs and phrases. The current technology expands the designers scope quite dramatically. The designer can now identify the features of the package, including the visuals and the text statements. Furthermore, the designer need not make arbitrary decisions up front, prior to the package research. Rather, the designer can let the consumer (here the soldier) respond, and identify the key features that 'turn on' the consumers. Furthermore, the segmentation allows the designer to identify segments in the population who may have different preferences. Finally, the optimization procedure empowers the designer to incorporate these different winning elements into new concepts for further refinement.

The Next Two Generations In Package Design - Concepts With Videos, And Package Concepts As Overlays

Up to now this presentation has concentrated on different packages, as static pictorial elements, with the words and pictures presented together on the equivalent of a concept board (viz., the computer screen). The growth of multi-media computing has given package designers and researchers new capabilities for testing with consumers at the early development phase. We will now explore two next generation approaches - video, and package concepts as overlays of transparencies.

Video In Concepts

Packaging involves person-product use. Information can be conveyed by videos that could not be conveyed by words and static pictures alone. By incorporating videoclips into the package concept (in place of, or in addition to static pictures), the package designer may be able to identify the utility (or lack thereof) of specific features which are demonstrated in use. Recently, Moskowitz, Gofman & Tamber (1994) presented the results of a study with "baby wipes" (pre-moistened towelettes), in which the elements were video clips as well as static pictures. The same picture scored quite differently when it was presented in a live action videoclip. We may expect to see similar types of differences for military packaging, especially when the concept elements deal with the usage patterns, and the actual motor activities involved when the soldier encounters and opens the package.

Static Package Concepts As Combinations Of Overlays

The building block approach to packaging concepts presented here has been advanced to a purely visual approach, in which the elements are components of the package. Elements may be closures, package graphics, package shape, etc. The elements are superimposed upon each so that the combination of these layers of elements generates a single package. In this way the panelist need not intellectualize.. Rather, the panelist is presented with a series of systematically varied package designs, each of which looks like a package. There is no description of the features (unless desired). The panelist judges the entire package on the relevant attributes. Afterwards, the researcher creates the mathematical model relating the presence/absence of each element to the rating attribute. The procedure enables the package developer to create package designs, and modify them in real time under the consumer's guidance.

An Overview

This paper has presented a new technology for the development of packages. The approach enables the package developer to identify those specific features of a package which attract the customer (here the soldier). There are three key benefits of the approach:

a) Efficiency - With relatively little effort package developers can sift through many alternative elements of a package in order to identify potential winners, and screen out potential losers.

b) Database & Segmentation - The data enable the developer to segment the consumers on the basis of patterns of preference for different elements. Typically these newly emerging subgroups (or concept response segments) show different patterns of what they like versus dislike. In this study as in other studies it is clear that the segmentation more effectively divides the large base of consumers into different subgroups than do other methods of segmenting (such as length of time in the field for soldiers).

c) Pro-Active Design Using Consumer Inputs -The data enable the designer to create new package concepts by recombining winning elements into new, and presumably more powerful concepts.

References

Green, P.E., & Srinivasan, 1990. Conjoint analysis in consumer research: Issues and outlook., Journal Of Consumer Research, 5, 103-123.

Moskowitz, H.R. 1981. Psychophysical approaches to package design and evaluation. In: Handbook Of Package Design Research, pp. 505-534 (W. Stern, ed), New York, John Wiley.

Moskowitz, H.R. 1994. Food Products And Concepts: Just In Time Development, Chapter 1, Food And Nutrition Press, Trumbull.

Moskowitz, H.R., Gofman, A., & Tamber, N. 1994. Using multi-media in package concept testing. Paper presented at the ASTM Packaging Symposium, Montreal, May. (To appear in an edited volume by L. Wu & Ayn Gelinas)

Moskowitz, H.R., Jacobs, B.E., & Lazar, N. 1985. Product response segmentation and the analysis of individual differences in liking. Journal Of Food Quality, 8, 168-191.

Plackett, R.L. and Burman, J.D. 1946. The design of optimum multifactorial experiments. experiments. Biometrika *33*, 305-325.

Szabo, B., & Babuska, I. 1991. Finite Element Analysis. New York, John Wiley.

Appendix I - Computational Grid To Estimate Utilities Of Elements Not Directly Tested

1) Locate each elements on a set of axes. The axes are 6 semantic differential scales shown in Table 2. A small group of 15 soldiers rated each of the elements.

2) Compute the geometric (Euclidean) distance between all pairs of elements in a 6 dimensional space. For each point choose the 8 closest neighbors.

3) Create a sequential list of each element, beginning with the first element in the first category, and finishing with the last element in the last category. The order in this list is fixed. Next to each element put in its coefficient from the dummy variable regression analysis. For elements that the panelist did not test put in the value -999.

4) Begin with the first element on the list. If that element was actually evaluated by the panelist, then skip to the next element on the list. If that element was not actually evaluated by the panelist, then replace the value for the element by the arithmetic average of the 8 closest neighbors. [Some of these neighbors will have the number -999. Simply average the utilities of all 8 closest neighbors, whether or not those neighbors had been directly tested]. Go through the entire list in this fashion.

5) Repeat step 4, going through the list of elements again and again, until there is no change in the replacement value of the untested elements. Set a minimum difference to denote "no change". Continue step 4 until the change in any element value is less than the prescribed and pre-defined minimum. At this point the data has reached steady state.

6) The result is an estimate of all the utilities of all elements, including both those directly tested, and those not directly tested but rather estimated. Table A shows an example for a single individual, of the utilities for elements that were tested and the estimates for elements were not directly tested, but rather estimated.

Table A - Utilities For A Single Panelist (#101) For Five Elements - Tested & Untested

Element	Coefficient	Tested?
Field break	9.23	Yes
Ziploc plastic bag with a tear strip across the top	-38.9	Yes
The ration is lightweight and compact	0.04	No
Food that is appetizing, and convenient!	3.77	No
Checkerboard triangle of Natick	-1.56	Yes

Appendix II - Segmentation Of Consumers Based Upon Pattern Of Responses To Individual Elements

The method requires plotting an individual's utilities (estimated coefficients) on the Y (one point for each element in the study), versus the location of that element on a semantic differential scale on the X axis. [Recall that each element has associated with it a value of each of 6 semantic scales, from Step 2].

The plot is a scatter-gram. We can fit a quadratic function to the scatter-gram: Individual Utility = k_0 + k_1(Semantic Scale) + k_2(Semantic Scale)^2. The foregoing equation reaches its maximal level for some level of the semantic differential scale.

Do this analysis for each person 6 times, one for each of the 6 different semantic scales. Each person generates 6 different *optimal semantic scale values*, one for each semantic scale. The data comprises 109 rows (one for each of the 109 soldier panelists) and 6 columns (one for each semantic scale).

Cluster the soldiers to create different subgroups of consumers. Individual soldiers in the same cluster show similar patterns of responses.